Innovation Disclosure

Docket No.: 99RSS133
Ranking:

1. Innovator(s)

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2. Title of Invention

Universal Cell Phone to USB Adapter
Find enclosed the attached document "cellPhone_USB.doc " (attached below in 3. Problem Solved) for all the questions listed below

3. Problem Solved

Digital cell phone user must purchase unique adapter and PC card for each digitial cell phone type.

The purpose of this document is to describe a new invention ("box") that fits between the digital cellular phone and personal computer. This box has the purpose of processing and translating signals to and from the cellular phone system for the use on the PC. For the purposes of this document, Mobile Phone Controller (MPC) refers to the box, the phone side refers to the cellular phone to MPC connection, and the PC side refers to the MPC to PC connection.

All the PDC and pHS phones (NTT carrier service) have a standard, but different, cellular phone connector (see figure 1, 2, and 3 below) on the phone side. NTT DoComo (the biggest Japanese cellular phone carrier) defined the phone side connectors for each system (i.e., each phone has one connector type per system and does not vary from manufacturer to manufacturer). There is no defacto or industry standard connector for the PC side for either system. The PC side connector is unique, requiring each PC OEM notebook maker that supports a cellular phone to provide a unique connector on the notebook. This introduces additional costs associated with maintaining a larger inventory, with higher costs of manufacturing for PC OEM and with the need to be designed -into the PC motherboard.

Note this description applies only to digital cellular phone systems.

see "cellPhone_USB.doc " for more detail

4. Previous Solutions

Each PC OEM must install an unique card and cable set for each type of cell phone. This requires inventory storage on many types of connectors.

Hardware Implementation

All of the following text and figures target the PDC connector on the phone side, but this material applies equally well to PHS (and to other digital cellular phone systems and upgrades of existing digital cellular systems).

Previous Hardware Implementation

See Figure 4.

Figure 4 shows an actual PCI modem design that supports PDC high-speed logic. This logic is composed of a Phone side interface box and a digital translation box. The modem Data Pump, DAA, and Audio Interface boxes are not the topics of this document and are included for context.

The PC OEM installs the PC Side Interface Connector, and electrically connects the Interface to the modem controller. The modem controller contains the digital translation block that performs synchronous and asynchronous functions for the PDC data channel and control channel, respectively. The controller and connector may limit the feature addition of support for other digital cellular systems. This limitation may occur in one of three ways - (1) the controller supports multiple formats, but the requires a different pin out, hence, the connector may require changing; (2) the controller is totally unsuited for the new format; and (3) both controller and connector are unsuitable. In the first case, a new connector is needed with specific wiring requirements to the controller. In the second case, a new PC laptop motherboard re-design is necessary. The third case suffers the limitations of case 1 and 2.

Previous Hardware interface

See Figure 8.

Figure 8 shows the mobile phone side and PC side (DTB is the Digital Translation Block) interface used to connect a PDC cellular phone to an actual modem prototype board.

As shown in Figure 8, the PDC connector can exchange up to sixteen signal between the phone and the modem, however only eight signals are used in PDC high speed and in PDC packet mode. Each PC OEM has its unique connector on the PC side and cable wiring from the connector to the DTB (Digital Translation Block), even in using the same DTB and modem chip set.

Previous Software Architecture

The modem control stack handles all parts normally associated with an AT-style modem - the DTE interface, the data handling, AT parsing, command storage and retrieval, and data pump control. Figure 6 shows a current implementation. This figure shows that within this modem architecture special mini-driver (called plug-in modules) modules connect to the modem control stack to perform the digital cellular protocol. The Port driver loads each plug-in as needed. A new plug-in is required for each digital cellular protocol. The Cellular Protocol Stack contains additional protocol code and DTE control (through AT commands). All the hardware accesses are done through the Hardware Access layer.

See Figure 6.

5. Solution

Add digital stack (e.g., PDC, GSM, PHS, etc.) to USB node. This node is small and bus-powered.

New Hardware Architecture

With the new hardware architecture, the modem controller does not change. A PC software change and a new MPC (Mobile Phone Controller) are all that is necessary to support a different digital cellular system

(or feature addition in current digital cellular system support).

See Figure 5.

Figure 5 shows the new MPC (Mobile Phone Controller) hardware design solution. The MPC (Mobile Phone Controller) contains three functional blocks. The Phone Side Interface (same functionality as the PC side connector in Figure 4), the Digital Translation Block "DTB" (same functionality of the block contained in the modem controller in Figure 4), and a USB SIE (Serial Interface Engine).

The Serial Interface Engine handles the serialization and de-serialization of USB transmissions, as well as the USB protocol. The USB SIE is the interface between the MPC and the USB connector of the PC.

Note that the MPC is not part of the controller chip. Therefore, one can support a new digital cellular system (or wireless feature) without designing in a new modem into a PC motherboard (or some similar design, such as a small board that connects to the motherboard through a specialize bus). One can add features by - (1) new PC software; or (2) new PC software and different MPC.

Note that the USB port on the PC is a multi-function port that may be used for non-digital cellular phone connections such as mouse, keyboard, other modems, and cameras.

New Hardware Interface

The cellular phone will be connected to the Personal computer through the USB connector. The PC OEM does not need to install any specific connector on the notebook to be able to support PDC/PHS or other cellular phone systems.

As outlined in Figure 5 and shown in much greater detail in Figure 9, the DTB (Digital Translation Block) function moves out of the PC to the external MPC. As a reminder, the MPC (Mobile Phone Controller) sits between the cellular phone, the PC, and the DTB (Digital Translation Block) part of the MPC implements the framing and synchronization logic. The USB connector interfaces to the MPC (Mobile Phone Controller) through the standard USB connector. USB connectors are available on all the PC made since 1997.

See Figure 9.

New Software Architecture

To be able to support this solution in the software level, one adds the USB stack interface onto the existing Hardware Access layer on the modem (note that the PCI interface is present and omitted for clarity). The OS (or some other third party) provides the PC USB stack.

See Figure 7.

Name of Pins	PDC High-speed Data Mode Signal Description	Direction
TCH_TX	Transmit synchronous data (28 Bytes / frame)	PDC←PC
TCH_FRAME	This signal tells if the current frame is Rx (H) or Tx (L).	PDC→PC
TCH_CLOCK	Clock signal (42kbps bit rate intermittent clock)	PDC→PC
Cell_TX	TX control serial data (600 – 9600 bps)	PDC←PC
Cell_RX	RX control serial data (600 – 9600 bps)	PDC→PC
TCH_RX	Receive synchronous data (28 Bytes / frame)	PDC→PC
ADP	Indication whether PC is connected to PDC.	PDC←PC

Figure 1. PDC High-speed Phone Side Data Mode Connector

Name of Pins	PDC Packet Mode Signal Description	Direction
TCH_TX	Transmit synchronous data (HDLC frame)	PDC←PC
TCH_FRAME	This signal tells if the system is in communication.	PDC→PC
TCH_CLOCK	Clock signal (42kbps LAPB clock)	PDC→PC
Cell_TX	TX control serial data (600 – 9600 bps)	PDC←PC
Cell_RX	RX control serial data (600 – 9600 bps)	PDC→PC
TCH_RX	Receive synchronous data (HDLC frame)	PDC→PC
ADP	Indication whether PC is connected to PDC.	PDC←PC

Figure 2. PDC Phone Side Packet Mode Connector

Name of Pins	PHS Signal Description	Direction
BITC(TCH_Clock)	Bit clock (uplink/downlink common 32kHz or 64kHz bit clock)	PHS→PC
UFCK	Flame clock signal for Tx data	PHS→PC
UDT (TCH_Tx)	Transmit synchronous data	PHS←PC
DFCK	Frame clock signal for Rx data	PHS→PC
DDT (TCH_RX)	Receive synchronous data	PHS→PC
USDT (Cell_Tx)	TX control serial data (2400 bps)	PHS←PC
DSDT (Cell_RX)	RX control serial data (2400 bps)	PHS→PC
CRC	CRC error notification	PHS→PC
ASLP	Adapter wake-up signal (To wake up the PC adapter)	PHS→PC
RDY (ADP)	Adapter detection signal	PHS←PC
PSLP	PS wake-up signal (To wake up PHS phone equipment)	PHS←PC

Figure 3. PHS Phone Side Connector

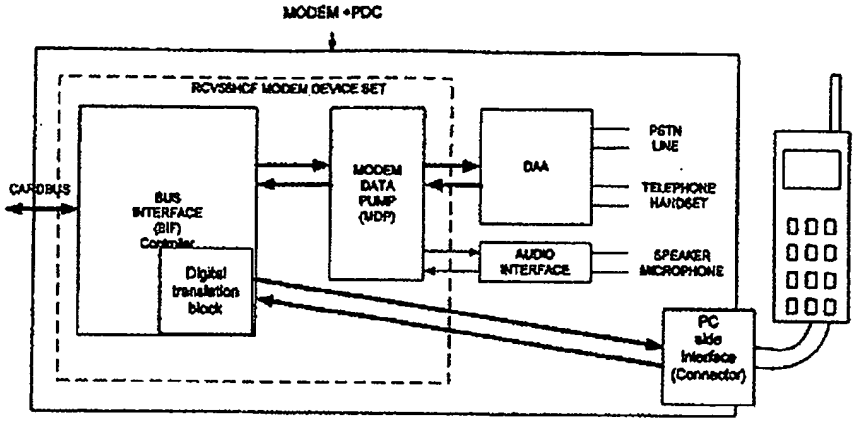

Figure 4. Actual hardware interface

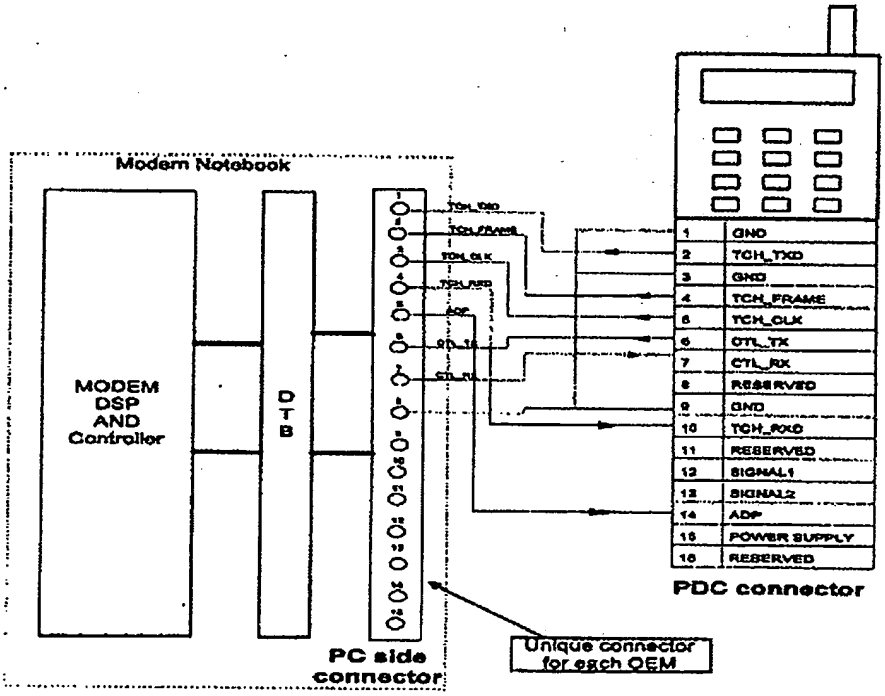

Figure 8. Cellular phone interface

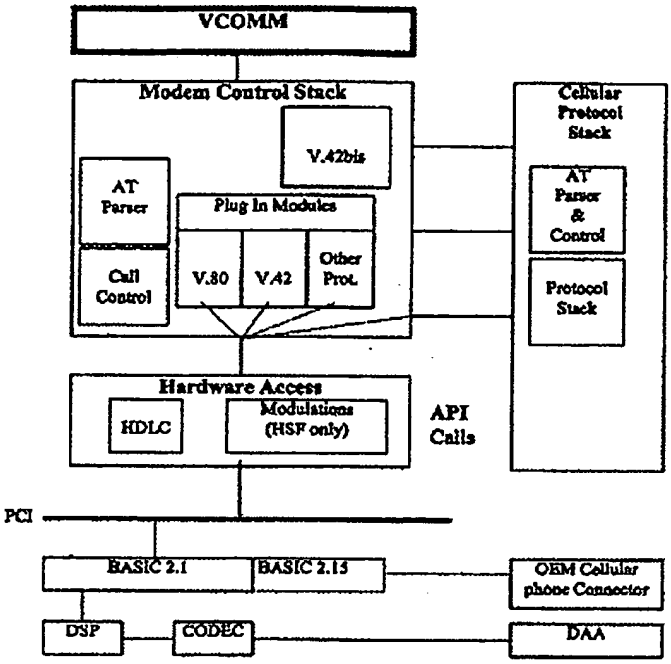

Figure 6. Modem software interface

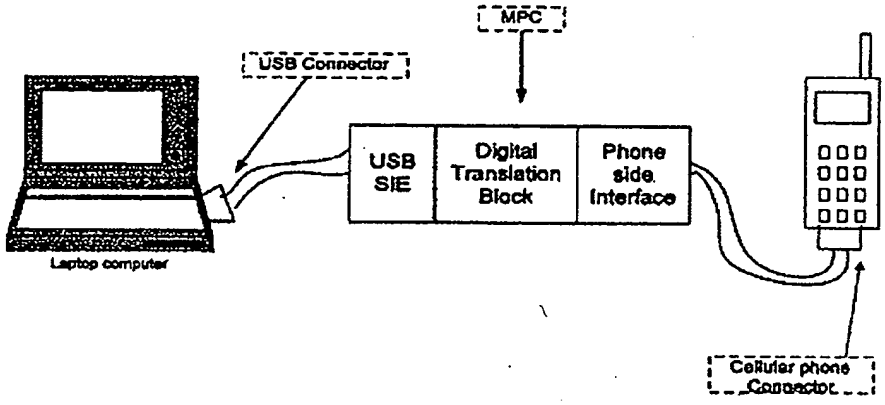

Figure 5. New hardware interface

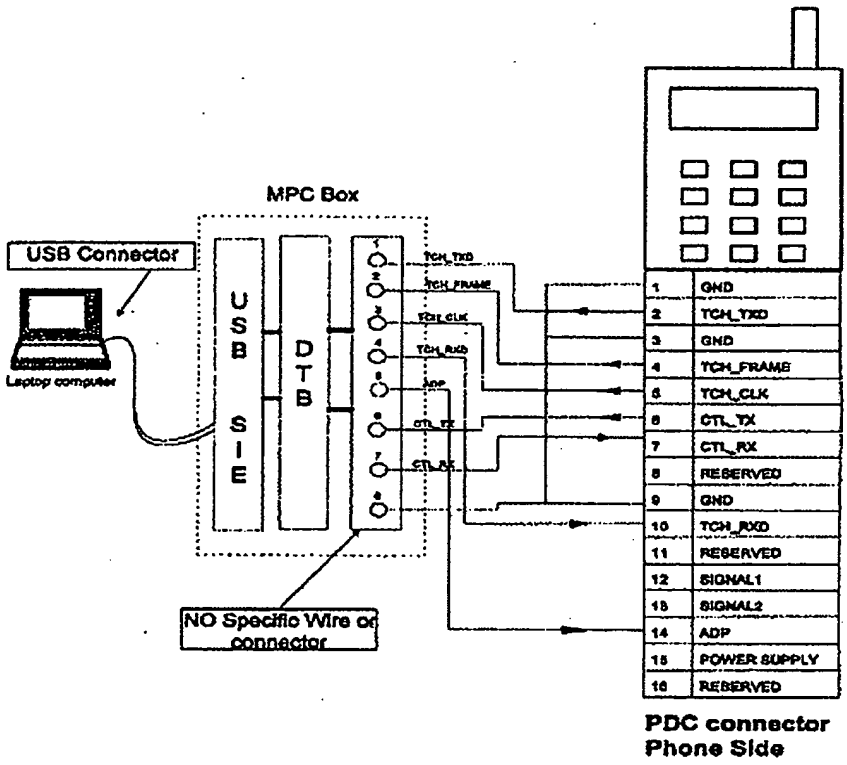

Figure 9. Hardware architecture

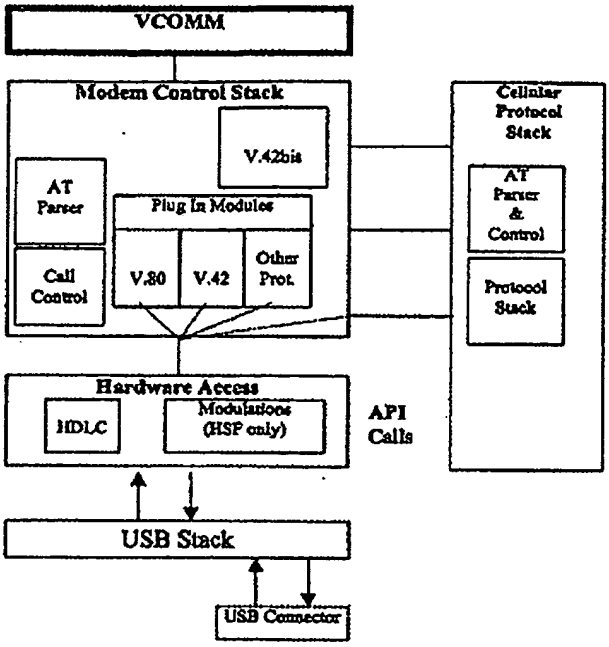

Figure 7. New Software Interface

cellPhone_USB.

6. Differences/Advantages Over Previous Solutions

Advantages:

A Personal Computer (PC) that does not have any unique digital cellular connector can support the cellular phone data/fax features if the PC has a USB connector (most, if not all, PCs made since 1997 have a USB connector). The PC's USB connector is multifunction and may serve other I/O from other devices.

The USB has a higher data bandwidth (approximately a net 8 Mb/s) than the current PC RS-232 support (1 15.2 Kb/s). The new generation of the PHS phone can have a speed of data transfer up to 384 Kb/s.

The PC OEM does not need to install a unique card and cable set for each type of cellular phone

The PC OEM does not require inventory storage of many types of connectors.

The PC OEM does not need to add any supplementary connector on the Notebook, in addition to the USB connector (reduce cost for PC OEM).

A user can use the same cellular phone cable with different PC OEM notebook.

MPC solution can be sold as a separate product after the end-user PC purchase.

The MPC is bus powered, requiring no external power brick.

Disadvantage:

A separate and non-integrated solution may have a higher BOM, but not necessarily result in a higher net system BOM when the cost of the unique connector is taken into account.

7. Status of Innovation

Idea If "Other", please specify

8. Product or program in which innovation will be used:

HCF/HSF host controlled modem products or stand along wireless product.

9. Has anyone disclosed or does anyone plan to disclose your innovation outside the Company?

○ Yes ● No ○ Don't Know
If "Yes", where:

10. Has anyone proposed or does anyone plan to propose a product or program to a customer which includes your innovation?

○ Yes ● No ○ Don't Know
If "Yes", when and how:

11. Innovator signature(s): (Do not use black ink)

_____ **Date** _____

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